MINIMUM ESTIMATES FOR VOLUME REMOVAL FROM THE MARTIAN FRETTED TERRAIN BETWEEN 270°W and 360°W, **Andrew M. Dimitriou, University of Massachusetts, Amherst, MA 01003.**

Martian fretted terrain has been a subject of study since the return of Mariner 9 data (1) and the original morphological description as offered by Sharp (1) has been widely accepted. This description is of a once continuous heavily cratered plateau which has since been subject to extensive erosion. The plateau remnants stand topographically higher as outlying "knobs" and "mesas" amidst onlapping stratigraphically younger plains materials. The best exposed area of fretted terrain on Mars lies between 270°W and 360°W in a 5-10 degree wide zone around 40°N. Work has been done in this area on the nature and origin of the debris aprons and fretted valley floor lineations (2,3) and principal component analysis attempted (4) on the outlying "mesas" in order to explain the observed distribution as a function of structural trends and erosive events. This abstract outlines the method used to estimate the volume of former plateau material that has been removed from this well exposed area of fretted terrain. The method attempts to place relatively hard lower bounds on these estimates. Upper bounds are more uncertain because inferring the extent of plateau material buried beneath plains to the north is difficult. The quantification is important because this region provides a very obvious source of material available for redistribution, and the lowlands to the north have acted as a sink for sedimentary material. The source volumes obtained here can be compared to the sink volumes required to bury large areas of the lowlands with a view to placing this regional contribution into a global context.

Three models are presented for the former extent of a once continuous heavily cratered plateau that has since been dissected and eroded. Within these model areas, outlying "mesas" and "knobs" (hereafter grouped as mountains) are separated for analytical purposes into two groups based on exposed surface area. Mountains >40 km^2 are termed large mountains, those <40 km^2 small mountains.

The southern and western limit for all three models is identical and well defined by the present boundary between fretted terrain and the heavily cratered plateau. The northern limit for all three models is less well defined because it is gradational. Between 300°W and 350°W, the northern boundary is inferred from the limit of occurrence of larger (>40km^2) mountains, which is an irregular east-west trace at about 49°N. East of 300°W, the three models have different NE limits, none of which coincides with the observed limits of fretted terrain. These northeast limits define the different model areas.

The smallest area (model 1) is bounded by a northwestward extension of the northwest trending graben sets visible on the upland surface at about 38°N, 305°W. This extension of a visible upland trend into what is now lowland is based on the postulate that the graben sets are the observable remnants of a series of northwest trending boundary faults that dissected the plateau surface and significantly dropped plateau material to the north and east. Some of the remnant mesas standing in this area of lowland appear to have long axes oriented parallel to this northwest trend. Any assumption of a continuous plateau thickness available for erosion north and east of these faults is not warranted, if this model defines the true initial northern limit of the plateau.

Model 2 includes the model 1 area but its northeast limit is farther eastward and is defined by a northwest-southeast trend at the abrupt limit of occurrence of outlying mountains. This is noted clearly around 43°N, 298°W. The rationale for this model is that this abrupt loss of mountains indicates a rapid drop in basement elevation which could be the limit of a plateau surface that has since been dissected, eroded and embayed by younger materials.

Model 3 includes all of the model 2 area and also an additional zone to the east as far as a northwest-southeast trace defined by the trend of the large irregular mesas centred on 35°N, 280°W. The mesas were identified by Wilhelms and Squyres (5) as rim remnants from their proposed 7700 km diameter Borealis basin. There is no observable evidence to indicate that a continuous thickness of plateau material was available for erosion north and east of this proposed rim boundary.

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Within all three areas, the exposed surface area of every large mountain was digitised, as was the enclosed area for each model. Shadow measurements were made at 16 locations on the continuous plateau boundary scarp and a mean height of 1.42 ± 0.52 km was determined. The quoted error not only includes the standard deviation, but a 2 pixel vertical error to account for slope rounding and shadow margin location problems as detailed by Parker et al. (6). Shadow measurements were made on 39 large mountains in a similar manner: the mean height of 1.45 ± 0.69 km agrees very well with that obtained from the scarp, strengthening the case that the mountains are remnant outliers of the plateau. In order to account for the volume of residual plateau material remaining within the model areas in the form of small mountains, five representative small subareas were located where the resolution permits a confident assessment of the surface areas and heights of small mountains to be made. An average of 3.3% of these five subareas is covered by small mountains and this is assumed to be a fair estimate across all three of the model areas. A mean height of 0.78 ± 0.41 km was obtained from 45 shadow measurements of small mountains. Ten shadow measurements were made on the margins of debris aprons visible on the extremely high resolution orbit 461B Viking images and a mean height of 0.07 ± 0.02 km was determined. Rather than attempt the extremely difficult task of identifying the percentage of the model areas covered by debris aprons, it was assumed that the entire lowland within each model area was completely buried by a debris blanket of the above thickness.

Estimates of volume removed range from 1.04 ± 0.60 M km^3 for model 1 through 1.53 ± 0.80 M km^3 for model 2 to 1.99 ± 1.10 M km^3 for model 3. This corresponds to a global equivalent sediment layer of between 3 and 21 m. If the northern lowlands is considered as the sole sink for this material a layer of between 9 and 60 m is indicated. These are minimum estimates because: (a) the thickness of plateau material measured does not represent the height above pre-plains basement but the height above the younger plains deposits (b) the northern inferred plateau limit is conservative; more plateau material may lie buried (c) the mountains were assumed to be flat-topped and have vertical cliff faces but are often conical or significantly rounded in cross-section.

As the volume of young material proposed to be present in the northern lowlands is significantly greater than that estimated above, the contribution of sediment from this area of fretted terrain is a small proportion of the lowland total.

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